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(71) Applicants  
Roderick Ian Woods,  
Physiological Laboratory, Downing Street, Cambridge  
CB2 3EG,  
James Burgess Hunter,  
12 Winton Gardens, Edinburgh EH10 7ET

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(72) Inventors  
Roderick Ian Woods,  
James Burgess Hunter

(74) Agent and/or address for service  
Langner Parry, 52—54 High Holborn, London  
WC1V 6RR

## (54) Padding for protective clothing

(57) A padding material for protective clothing has a backing sheet of cotton for example. A number of foam plastics plates (15), preferably each having a thickness of 3 mm, are stitched (16) or stapled to the backing sheet along common edges to provide freely movable opposite edges. The plates overlap each other by at least a quarter of the width of the individual plates in a direction transverse to the rows of stitching.

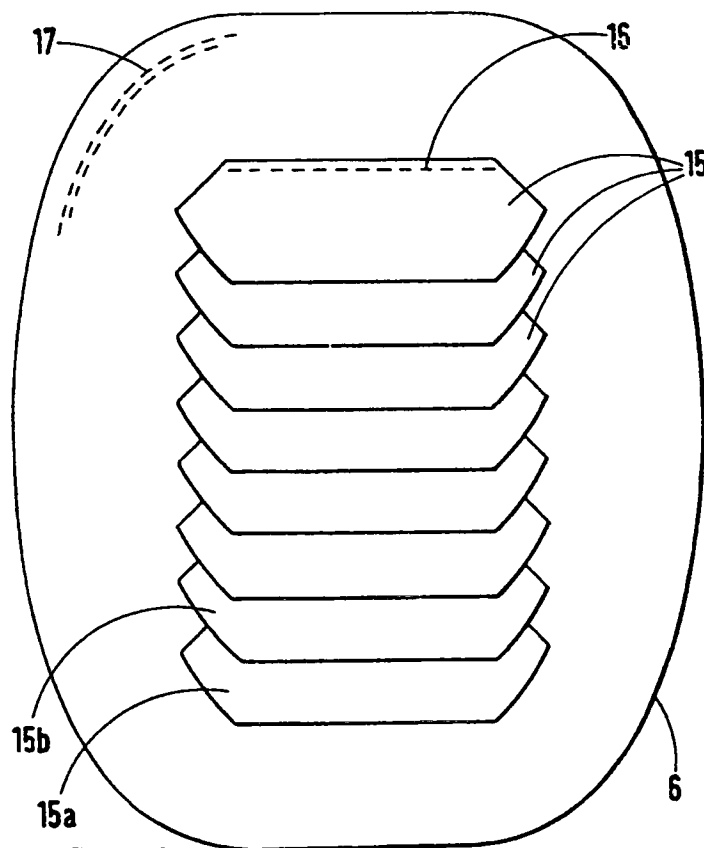
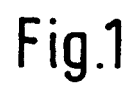


Fig.3

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.



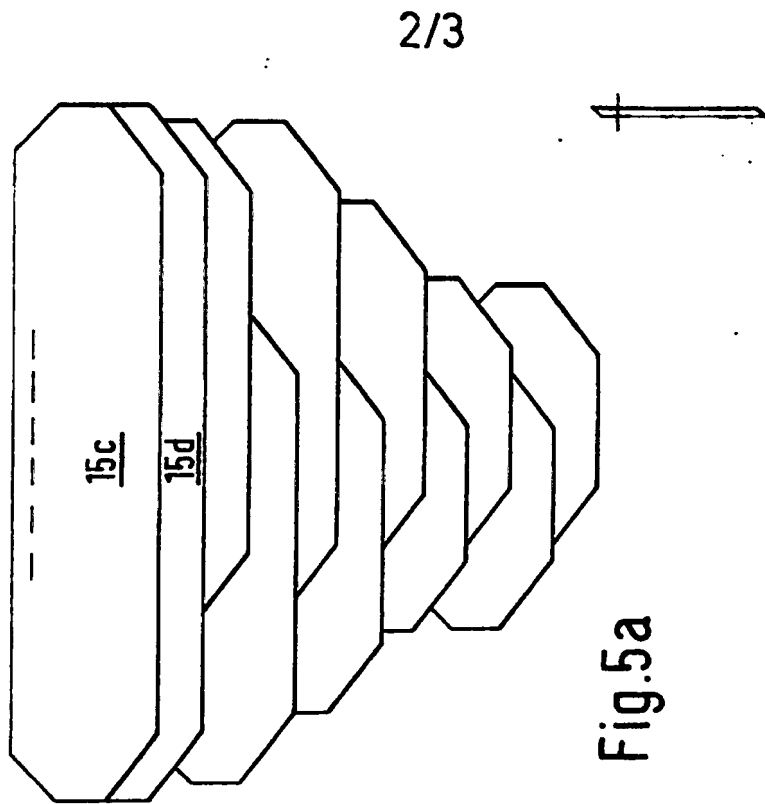
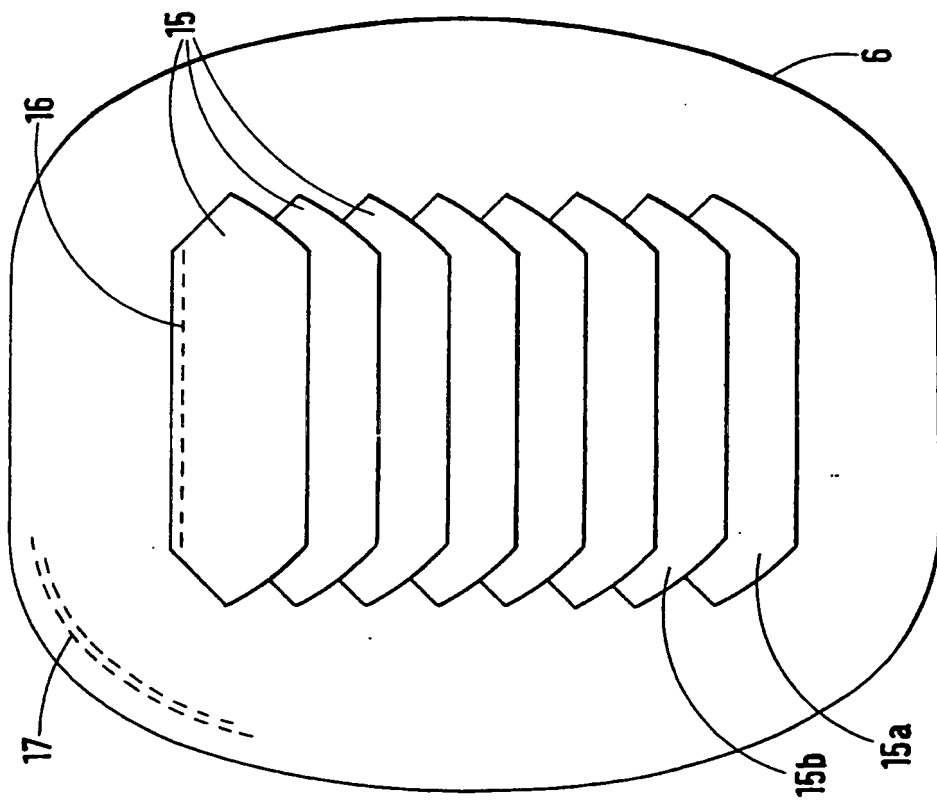


Fig. 5b

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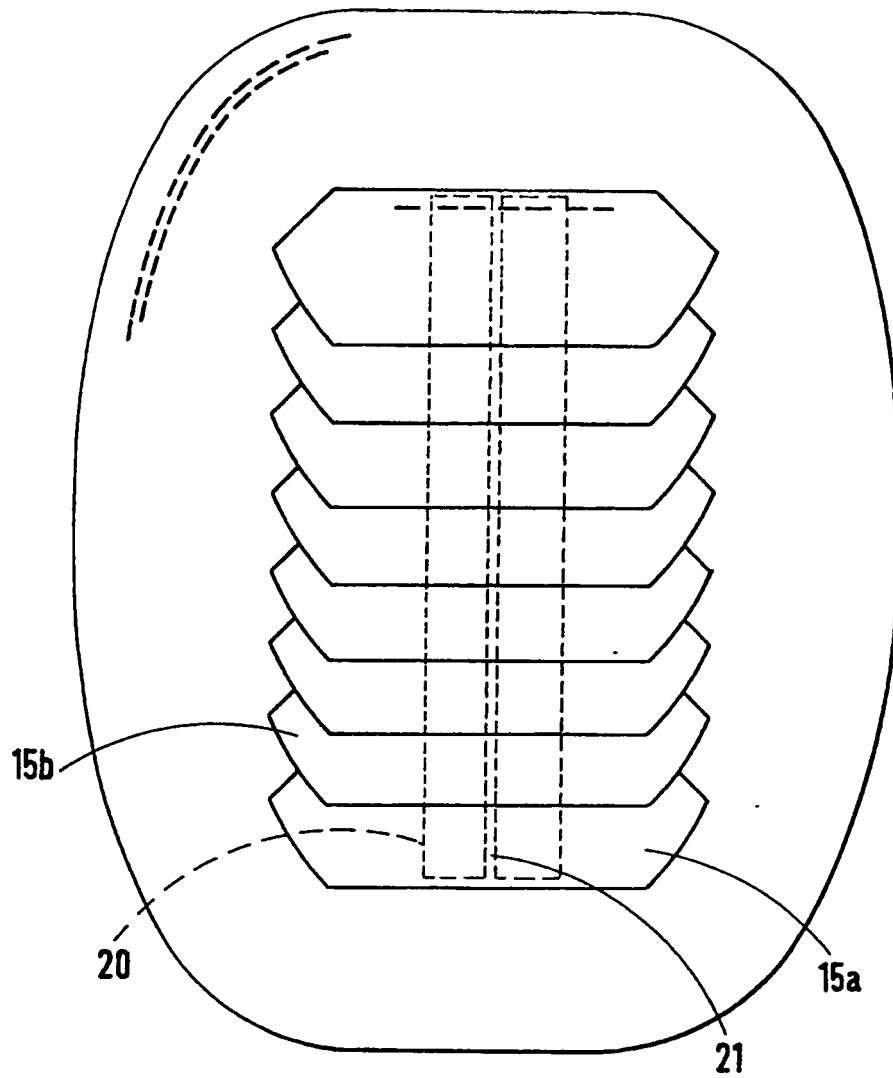


Fig. 4

## SPECIFICATION

## Padding for protective clothing

- This invention relates to padding for protective clothing for protecting persons subjected to physical forces resulting from occupational hazards or pursuits in which people may be accidentally or deliberately subjected to forces likely to cause soft or hard body tissue damage.
- It has already been proposed that the addition of various paddings to clothing will reduce the injuries of persons subjected to blows and that the use of strong padding materials will help to protect wearers from laceration, abrasion and impact.
- One particularly suitable type of energy absorbing foam is a mechanically frothed poly-urethane foam known as 'Cleron'. (Made under licence from BP Chemicals (Suisse) SA and marketed by Avalon Shoe Supplies Ltd.) Such foams have a high density of 300—500 kg/m<sup>3</sup> and may contain various fillers. When formed into thin sheets the sheets of energy absorbing foam are flexible, but when the sheets are 12 to 15 mm thick, as would be desirable for known forms of protective padding in clothing, the sheets are stiff and are not practicable, particularly where used in motor cycle clothing for example where maximum flexibility is necessary at all times.
- Therefore it is desirable to provide a padding material which utilises thinner sheets but has a high impact resistance, which sheet can be easily shaped by bending to be useful as padding in protective clothing at joint areas for example.
- The present invention seeks to overcome this problem by generally combining strong woven material with their sheets of highly efficient energy-absorbing plastic materials in a new way that enables them to be used together to greater advantage than hitherto known.
- According to one aspect of the present invention there is provided an article of protective clothing including padding material for protective clothing comprising a backing sheet and a plurality of plates of foam plastics material wherein substantially all the plates are individually attached to the backing sheet and are arranged to freely extend over an adjacent plate by an amount equal to at least a quarter of the width of the plates in the overlapping direction of the plates.
- In a preferred form of padding material according to the present invention each plate is attached to the backing sheet by a row of stitching, the rows of stitching preferably being parallel to each other. Each of the plates are identical and elongate with its row of stitching lying parallel to one longitudinal edge thereof. The plates may be of an irregular length.
- In an alternative form of padding an elongate strip of material is introduced between the backing sheet and plates, and is held in position by the stitching attaching the plates to the backing sheet. The elongate strip material is preferably divided into two portions to facilitate flexibility of the padding material. Conveniently, the elongate strip material is Petersham tape, although a thin elongate strip of foam plastics material can also be used.

The backing sheet to which the plurality of plates of foam plastics material are attached is formed of polycotton, pure cotton or woven Kevlar.

- It is preferred that the foam plastics plates have a density of 300—500 kg/m<sup>3</sup> and that the foam plastics is Cleron or a modified form of Cleron generally known in the trade as type RP1227. (Avalon Shoes Supplies Ltd.)

- According to another aspect of the present invention there is provided an article of protective clothing including padding material comprising a backing sheet and a plurality of plates of foam plastics material wherein substantially all the plates are individually attached to the backing sheet and are arranged to freely extend over an adjacent plate by an amount equal to at least a quarter of the width of the plates in the overlapping direction of the plates.

- The article of protective clothing has a main support material, preferably of a woven fabric of Kevlar, to which the padding material is attached. Individual pieces of Kevlar fabric are attached to each other by a seam in which the edge portions of the individual pieces are folded over and the folded region again fold inwardly of the Kevlar fabric. The two adjacent folded portions are then abutted and secured together by four rows of stitching to define a seam. In an alternative seam three or even two rows of stitching will suffice provided the seam is subjected to only light impacts.

- A particularly suitable type of strong material to use as a backing sheet is a fabric containing a high proportion of aramid fibre such as Kevlar (Registered Trade Mark) in a close weave such as D235 from Fothergill and Harvey PLC or KC600 from TBA Industrial Products Ltd., both these examples would normally be used in two layers. Such fabric materials need to be made up into garments in such a way that the seams are not weak points and allow the garment to come apart when it is subjected to severe forces.

- Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:—

- Fig. 1 is an expanded partial cross-sectional view illustrating a seam joining two pieces of woven fabric,

- Fig. 2 is a side view showing the stitching of the seam of Fig. 1,

- Fig. 3 is a side view of padding material with protective sheets shown thereon,

- Fig. 4 is similar to Fig. 3 with additionally divided strengthening strips, and

- Fig. 5 illustrates an overlapping arrangement of a shoulder pad.

- Referring now specifically to Figures 1 and 2 of the drawings there is shown a turned seam 1 formed from two abutting edges of two sheets 2 of woven fabric material forming the outer layer of a garment in which the outer surface 3 is smooth and without projections.

- Each edge of the sheet material 2 is folded inwardly at 4 with a further fold 5 to leave edge portions 6 of the respective sheets abutting one another and both ending just short of the smooth

outer surface 3 of the garment layer. The abutting folded end portions of the sheets 2 are secured together by four rows of stitching 8, which rows are spaced at three millimetres or four fabric threads apart whichever is the greater. The interconnected folded portions forming the seam lie inside the garment and are covered by the lining (not shown) of the garment.

Fig. 3 shows a backing sheet of fabric material to which there are attached centrally thereof a plurality of shaped foam plastics plates 15 each attached individually to the fabric by a single row of stitching 16. A double row of stitching 17 indicates the stitching used to attach the fabric material to a garment with the foam plastics plates against the garment material and the backing sheet against the inner lining of the garment.

Each of the foam plastic plates 15 is of an elongate structure with parallel elongate sides. Each end is chamfered inwardly and longitudinally outwardly to meet at a point which is equally spaced from each of the elongate side edges 18 of a plate. The first of the foam plates 15a, that is, the lowest shown in Fig. 3 is stitched on the fabric backing sheet in the position shown. The next foam plate 15b is stitched on the backing sheet with its rows of stitching 16 parallel to the row of stitching of the previous foam plate 15a, such that the plate 15b overlaps and extends across over half the width of the previous foam plate 15a.

This construction is repeated for each of the foam plastic plates to build up a series of overlapping plates as shown in Fig. 3.

In Fig. 4 there is shown a similarly constructed woven fabric backing sheet with foam plastic plates, but in this instance additional padding is provided by introducing the longitudinal strip 20 of either Petersham tape or a thin sheet the same material as the foam plastic plates. The longitudinal strip is positioned on the fabric backing sheet before mounting of the individual foam plastic plates 15 and when these plates are attached to the backing sheet as described above, the individual rows of stitching 16 for the foam plastic plates also attaches the longitudinal strip 20 to the fabric backing sheet. The provision of the longitudinal strip 20 gives added protection particularly where the backing sheet is used to protect a joint such as an elbow or knee joint which moves in one plane. However, the longitudinal strip 20 is divided longitudinally at 21 to provide additional flexibility without detracting from the additional padding properties. The longitudinal strip 20 can be a single undivided strip.

The embodiments described above have used identically shaped foam plastic plates which are 8 mm wide and 3 mm thick. However, it is not necessary for the foam plates to have the same shape and Fig. 5 illustrates the combination of a number of differently shaped foam plates which together form a protective shoulder pad with overall thickness of 12 mm although the plates are individually 3 mm thick. The rows of stitching for the plates shown in Fig. 5 lie centrally to the padding structure with the rows of stitching parallel with the uppermost edge of the foam plates. The lower

longitudinal edges and the longitudinal ends of the plates will be free to overlap other foam plates.

The plates vary in length and are located alternately to opposite sides of the padding to overlap over a central region extending upwardly through the padding in Fig. 5.

In Fig. 5 the top two plates 15c and 15d are attached to the backing sheet 6 by a single row of stitching 16a. The plates 15 in this embodiment are each 8 mm wide although plate 15c is only 5.5 mm in width. With such an arrangement the combined thickness of the plates is supplied at the major point of impact and yet retains flexibility.

By varying the shape and the overlapping of the plates combined thicknesses of 6 mm, 9 mm or 12 mm padding are obtainable.

In any of the above described embodiments the foam pieces are conveniently cut with a 45° chamfered cross-section to assist the stepping of the padding and the flexibility of the overlapping from plates.

The thread utilised for stitching in the above described embodiments is twisted thread of Kevlar (Registered Trade Mark) filaments or similar material, 0.2 mm in diameter. The thread is particularly suitable for securing the seam 1 for highly stressed points of garments which is made for example of fabric containing a high proportion of aramid fibre such as Kevlar in close weave such as D235 from Fothergill and Harvey PLC or KC600 from TBA Industrial Products Ltd. Both types of material would normally be used in two layers. The second and subsequent lines of stitches of a seam 1 such as that in Fig. 1, are protected from damage in the first stages of an impact by the first line of stitching being inside the main or outer fabric of a garment with a smooth outer face 3. The fold of the seam is inside the garment covered by the lining of the garment.

In the present invention the overall mechanically protective part of the garment, which also ensures the padding is held in the appropriate place, is made from two layers of a suitably strong material as described above with the seams thereof sewn together with the special seams 1 where necessary. As shown in Fig. 3, although applicable to the other embodiments, thin impact absorbing foam plates 15 are attached to backing sheets 6 of woven Kevlar material which are then sewn to the inside of the main garment such that the foam plates are located between the main garment and the backing sheet. The rows of stitches 17 attaching the backing sheet to the garment are placed so that they lie outside the main areas of probable significant damage.

The foam plastic plates 15 used in any of the embodiments described herein or the longitudinal strip 20 are made of thin sheets of 3 mm thickness of an energy absorbing foam which is preferably mechanically frothed poly-urethane foam known as Cieron (made under

The required thickness of the foam plates to provide the necessary protection is built up by the several overlapping thin foam plates 15 stitched to the backing material 6 one above another by a line of stitches 16 adjacent each upper edge thereof after

the general pattern of slates on a roof. Each foam plate is shaped such that it is slidable on adjacent plates and such that the whole assembly is easily worn and body movement is not unduly restricted even though overlapping thicknesses of 12 mm are achieved. The example shown in Fig. 3 is an elbow pad. For some joints like that of the shoulder, where complex movements occur, not all the foam plates will be of the same width, as shown in the Fig. 5

embodiment. Alternate wide and narrow plates, and plates of any shape can improve the fit of the padding. Further improvement can be achieved by heat forming the assemblies described above to the shape of the joint to be protected.

The thickness of the thin plates of foam plastics material is preferably 3 mm although thicknesses of 2 to 6 mm can be used depending upon the particular use to which the protective garment having the padding is to be put. Generally below 2 mm the tear factor of the foam plates becomes a problem whilst above 6 mm the padding becomes too stiff. Consequently, the 3 mm thickness used in accordance with the present invention provides the necessary strength and flexibility.

Advantageously, the material of Applicant's invention has specific use in a motorcyclist's jacket and trousers, for example. Such garments will retain their integrity on impact with a road surface at 112 km per hour and retain the energy absorbing pads over the joints and bones they are designed to protect by virtue of the overall construction of the garments and the specific overlapping mounting and fixing of the foam plates on the fabric backing.

The mechanically strong and impact energy absorbing element of a garment or local protective device as described above, may be covered or lined with suitable decorative, flame retardant, waterproof, windproof, insulating or otherwise specialised layers of fabrics or other materials providing that these do not interfere with the properties of the protective layers or introduce their own specific hazards to the wearer taking into account the likely use that the whole garment assembly will be put to.

The seam 1 of Fig. 1 is advantageously used to avoid destruction of a garment along the seams and whilst described as having four rows of stitching 4 three rows of stitching can be used. Where impact is unlikely to have any effect two or even a single row of stitching can be used.

When seams using Kevlar threads with rows of stitching were tested the seams were almost undamaged by road impact. The first row of stitches was found to have some damage and the second row of stitches very slight damage. The seams were always found to hold together and the turn of folds in the seam prevented any fibres pulling through the seam. Three rows of stitches are therefore adequate in this type of seam where heavy impact is expected. Four rows of stitching provides increased protection against destruction by impact.

Kevlar fabric is eminently suitable for garments in use everyday over a long period since the strength of the garments is maintained for long periods, and although more costly than other materials the major

part of the garment cost is in its manufacture and the extra cost of using Kevlar is minimal. The tightly woven Kevlar fabric D235 from Fothergill and Harvey PLC is ideal for motorcycle garments. It is thin enough and soft enough to be used in two layers throughout a jacket or trousers and to be sewn with the special seam shown in Figs. 1 and 2. Heavier grades of the Kevlar fabric that would probably not need to be used in two layers are very stiff and therefore less suitable. As with all woven fabrics the Kevlar fabric is available in continuous lengths with similar properties throughout, unlike skins from animals. However, other thermoplastic fibres with similar high degradation or melting temperatures and high strength should prove equal in performance to Kevlar.

The Kevlar containing jackets and trousers are preferably provided with Dartex microporous polyurethane outer covers. Whilst this material is not mechanically strong and melts in the test impacts, it is a very suitable type of material to cover motorcycle garments and protects the Kevlar fabric against ultra violet breakdown. Dartex waterproof and windproof while being adequately vapour permeable to prevent the accumulation of sweat under normal riding conditions. Dartex is also available in a range of colours including bright saturn yellow for maximum conspicuity. It is expected that for riders of motorcycles with full fairings like Police Patrolmen, for example, their coats would be covered with a replaceable outer of Dartex or similar material, but their trousers would preferably have plain woven nylon outers, with optional Dartex overtrousers supplied for wet conditions. It is preferable with such nylon trousers to provide a stretchable vinyl or leather seat to provide adequate friction with the saddle for safe riding at times of high acceleration or braking. The garments are conveniently sized to fit over the riders' normal working clothing or uniform. The arms and lower leg garment portions are conveniently a close fit but just loose enough for warm weather comfort and for use as a track-suit like garment of thick knitted, or similar flexible material to be worn in cooler weather. The torso and thigh portions are of a looser fit permitting the addition of a waistcoat and knee-length trousers of up to 250 g/m<sup>2</sup> polyester batt quilted material. This additional clothing permits prolonged high speed riding at an air temperature of 5°C on a fully faired motorcycle, but for colder conditions a padded windproof oversuit can conveniently be used. The mechanical protective clothing is not designed to be loose enough to accommodate more occasionally used inner clothing, because when it is not being worn, the energy absorbing padding could be more easily forced off the area it was meant to protect during an accident.

In yet another embodiment the padding material according to the present invention can be utilised as a nape protector to be attached to a motorcycle helmet. The backing sheet in this instance lies outermost so that the free edges of the plates 15 are facing inwardly.

Whilst the embodiments described in Figs. 3 and 4

illustrate an overlap which is at least half the width of the elongate plates, an overlap of at least a quarter of the width of the elongate plates is possible without substantially detracting from the protective

5 properties of the padding material.

Preferably, a supporting tape is used in the region of the stitching to prevent the stitching pulling through the foam plastics plates. In one alternative embodiment the stitching is replaced by staples.

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#### CLAIMS

1. A padding material for protective clothing comprising a backing sheet and a plurality of plates of foam plastics material, wherein substantially all the plates are individually attached along one edge thereof to the backing sheet and are arranged to freely extend over an adjacent plate by an amount equal to at least a quarter of the width of the plates in the overlapping direction of the plates.

20 2. A padding material as claimed in claim 1, wherein each plate is attached to a backing sheet by a row of stitching for the individual plates being parallel to each other.

3. A padding material as claimed in claim 2, wherein the rows of stitching for the plates are parallel to each other.

4. A padding material as claimed in any one of the preceding claims, wherein each of the plates are identical and elongate with its row of stitching lying parallel to one elongate edge thereof.

5. A padding material as claimed in any one of claims 1 to 3, wherein the plates are of an irregular length.

6. A padding material as claimed in any one of the preceding claims, including an elongate strip of material extending transversely to the plates and located between the backing sheet and the plates and supported by the attachment of the plates to the backing sheet.

40 7. A padding material as claimed in claim 6, wherein the elongate material is divided into two portions.

8. A padding material as claimed in claim 6 or 7, wherein the elongate strip is of Petersham tape.

45 9. A padding as claimed in any one of the preceding claims, wherein the plates are pre-shaped by heating to the general contours of a joint to be protected.

10. A padding material as claimed in any one of the preceding claims, wherein the backing sheet is of polycotton, pure cotton or woven Kevlar.

50 11. A padding material as claimed in any one of the preceding claims, wherein the foam plastic plates have a density of 300 to 500 kg/m<sup>3</sup>.

12. A padding material as claimed in claim 11, wherein the foam plastic plates are formed from Cleron.

13. An article of protective clothing including padding material comprising a backing sheet and a plurality of plates of foam plastics material, wherein substantially all the plates are individually attached along one edge thereof to the backing sheet and are arranged to freely extend over an adjacent plate by an amount equal to at least a quarter of the width of the plates in the overlapping direction of the plates.

65 14. An article as claimed in claim 13, wherein the article is formed of a woven fabric of Kevlar.

15. An article as claimed in claim 13 or 14, separate pieces of the article are joined with a seam comprising abutting folded edge portions of adjoining pieces of the article, which abutting portions are sewn together with a plurality of rows of stitches.

16. An article as claimed in claim 15, wherein four rows of stitches are provided.

75 17. An article as claimed in claim 16, wherein the four rows of stitching are each 3 mm or four fabric threads apart.

18. A padding material for protective clothing substantially as hereinbefore described with reference to and as illustrated in Fig. 3; or Fig. 4; or Fig. 5 of the accompanying drawings.

80 19. An article of protective clothing substantially as hereinbefore described with reference to Figs. 1 and 2; or Fig. 4; or Fig. 5 of the accompanying drawings.